Your Questions Answered (33)
Fuel Oil System Storage Tanks

earth safe
Fuel Systems for Critical Power

1.1 When are aboveground tanks preferred?

Aboveground tanks are preferred when the following conditions are important factors:

1. The facility owner / operator has had a prior environmental problem with a UST.
2. The property is leased and the owner prohibits underground tanks.
3. The facility may require future relocation, expansion, or removal of the tanks.
4. The facility has a high underground water table, or high rock elevation, or other consideration such as required shoring that significantly increases the cost of an underground installation.

1.2 When are underground tanks preferred?

Underground tanks are preferred when the following conditions are important factors:

1. The use of aboveground tanks is restricted or prohibited by local fire code or zoning.
2. The space limitations of the site would not allow for the footprint and setbacks required for ASTs.
3. The facility owner / operator believes that the underground tanks are more secure against vandalism.
4. The visual / aesthetic / architectural aspects of the building require an underground tank.
5. Gravity overflow protection from generator day tanks is a critical concern.
6. Gravity filling of the tanks is a critical concern, based on local fuel supply availability.
7. Cold weather considerations are critical and heating of tanks and piping is undesirable.

1.3 What are the positives and negatives for aboveground tanks?

Positives:

1. Inherent visual security that there are no leaks.
2. Lesser requirements for period testing for regulatory compliance.
3. Lower cost of installation – usually.
4. Easier access for modification or maintenance.
5. Easier to remove or relocate.
6. Can be installed by the general mechanical contractor, specialty tank contractor not required.

Negatives:

1. Space requirements.
2. Visual / aesthetic impairment.

3. Higher security requirement and potential for vandalism.
4. Safety issues for tank top access.
5. Requires delivery truck to be pump equipped.
6. Potential for overfills, spills, siphoning of fuel.
7. Requirement for pump return flow from day tanks.
8. Cold weather and hot weather issues.
9. Day / night thermal changes may increase condensation.
10. Perception of fire hazard.
11. Local use prohibitions or size limitations.
12. Inspection and maintenance of open dike areas if used.

1.4 What are the positives and negatives of underground tank?

Positives:

1. Widely accepted without size limitations.
2. Saves space at ground level and allows for site access by driving above tanks.
3. No visual / aesthetic impairment.
4. More secure against vandalism.
5. Well defined regulatory requirements.
6. Stable thermal environment.
7. Allows for fuel delivery by gravity.
8. Allows for gravity overflow return from day tanks.
9. Secure from fire hazards.

Negatives

1. Higher requirements for periodic testing for regulatory compliance.
2. Perception of greater environmental risk based on past experience.
3. Requirement for environmental liability insurance to meet regulations.
4. Higher cost of installation – usually.
5. Difficulty to expand, modify, relocate, or remove.
6. Requires specially licensed installation contractors.

1.5 Which is less expensive – underground or aboveground tanks?

Aboveground tanks will typically be less expensive, but not dramatically once all requirements are met for foundations, security, overfill prevention and other requirements.

Special requirements that will increase the costs of an aboveground tank:

1. fire-rated tank construction.
2. heating of tanks and piping.
3. double containment of aboveground piping with steel pipe secondary.
4. special fire suppression.
5. special access stairs and platforms for tank top access.
6. security fences or architectural enclosure walls.
7. seismic requirements for aboveground piping supports.

Special requirements that will increase the cost of an underground tank:

1. Excavation requirements that include shoring, dewatering, rock excavation, or underground utility protection.
2. Piping lengths and slopes that require additional burial depth for the tank.
3. Full ballast capacity design for the hold-down concrete slab.

1.6 What sizes or capacities of tanks are available

Underground and aboveground tanks, shop fabricated and UL listed, are widely available up to 40,000 gallon capacity, and to 50,000 gallon capacity in some areas. Aboveground tanks that are field fabricated, API design tanks are available in higher capacities.

2.1 Which is preferred – fiberglass or steel underground tanks?

Both fiberglass and steel tanks are widely used for emergency generator applications. Both are built to UL standards and are inspected and certified by UL procedures. The steel tanks are typically a composite design that includes a fiberglass secondary containment that also provides corrosion protection.

Fiberglass tanks are manufactured by 2 primary US manufacturers: Xerxes Corporation, and Containment Solutions (the old Owens Corning brand). Steel tanks are manufactured by a relatively large number of manufacturers, typically local or regional firms, and typically members of the Steel Tank Institute. Modern Welding is the only national steel tank manufacturer, and Highland tank is a prominent manufacturer serving the East and Midwest.

In general, fiberglass manufacturers promote corrosion-proof designs, and steel tank manufacturers promote higher strength and chemical compatibility for future fuels.

The price comparison between fiberglass and steel tanks varies in time and place, based on oil chemical prices, steel prices, and freight prices. In general they are comparable.

2.2 What are the benefits of fiberglass tanks

1. Corrosion-proof materials. This is the traditional selling point since older steel tank designs failed because of corrosion. New composite designs of steel tanks have addressed this issue. However freedom from internal corrosion is still an advantage. Water from condensation accumulates in the bottom of tanks and can assist in the internal corrosion of steel tanks.
2. Interstitial Monitoring System. The hydrostatic method of monitoring fiberglass underground tanks is widely used, and recognized as a positive method of leak detection by California regulations.

2.3 What are the benefits of steel tanks?

1. Wide Availability. Steel tanks are widely available from various manufacturers that provide competing price and delivery.
2. Installation Resiliency. Steel tanks are more tolerant of variation in installation handling and backfill procedures.

2.4 What are the site considerations for underground tanks?

The code requirements for underground tanks are typically 5 feet from building walls and 15 feet from property lines. Consideration should be given to the access for fuel delivery trucks to the tank area, and remote fill stations should be planned if needed.

The tanks may be located in paved areas, since properly installed they are not damaged from vehicle traffic. If located in unpaved areas or in areas of bituminous paving, it is typically important to install concrete collars around the fill point and manways. The concrete collars work to prevent damage to tank top equipment, and provide a barrier for small volumes of fuel that may be present from tank fill or maintenance operations.

Mechanical designers will typically locate the underground tanks in locations optimum for operational performance. This allows for a minimum of pipe length from the tanks to the building wall or point of use. However the excavation aspects of tank installations can have important impacts on the project costs and schedule, and these should be considered as well. The tank installation is often the deepest excavation associated with the construction, so it is worthwhile to do some preliminary planning. Some aspects of the tank excavation are as follows:

1. Large tank installations squeezed between buildings and property lines can restrict access to the building for construction operations.
2. Tank installations can impact building wall stability where the tank excavation is below the building footing wall elevation. Shoring, even where practical and cost effective, can increase the risk of building settlement. Buildings on adjacent properties can also be impacted in the same way.
3. Tank installations behind retaining walls can impact the stability of these structures if they are within the soil zone of influence for the wall footings.
4. Existing underground utilities in the tank area may require relocation or support, and the tank installation may increase the risk of utility service to the building.
5. A high water table at a proposed tank installation may require dewatering which can increase the installation costs, and increase the risk of ground settlement. Handling of dewatering discharges can also be problematic and may require special permits.
6. A high rock elevation at a facility will increase the costs of excavation and tank installation. And the construction aspects of rock removal can cause vibration that is detrimental to adjacent buildings or utilities.

2.5 What are the construction issues for underground tanks?

Most State regulations require that a specially licensed contractor install all underground fuel tanks and piping. The licensing is typically predicated on initial testing and periodic re-testing or training as a condition of maintaining the license. States may also require that the licensed contractors are covered by liability insurance for environmental claims. Tank. Piping, and monitoring equipment manufacturers also have training and certification requirements for the installers of their equipment.

Besides the licensing of firms, many States also require the licensing of individuals who must be present at all or at least critical points of the installation. Besides the licensing requirements familiarity with special materials, tools, and techniques is typically required for underground tank installation.

Installation of underground tanks requires permits from States and / or local regulatory agencies. This is the start of an extensive set of inspection and approval procedures that are required throughout the installation. Typical inspection requirements are:

1. Inspection of the tank unloading and setting. This sometimes includes holiday testing of steel tank coatings and inspection of hydrostatically charged tanks.
2. Pressure testing of the primary tank, and / or pressure or vacuum testing of the tank secondary space.
3. Pressure testing of primary fuel piping after installation and prior to backfill.
4. Pressure testing of secondary containment fuel piping after installation and prior to backfill.
5. Liquid tightness testing of tank sumps or vacuum testing of double wall sumps.
6. Electrical inspections of conduit and wiring.
7. Mechanical inspection of complete fuel system.
8. Testing of high level alarms for tank fill overfill protection. Testing of leak detection sensors. Testing of remote leak alarms annunciation and monitoring.
9. Final inspection of fuel system including all safety interlocks, such as pump shutdown upon leak detection and emergency stops.

2.6 What are the regulatory issues for underground tanks?

All states regulate underground fuel tank installation and operation. The regulations have their basis in the federal underground tank rules that were first established in 1988 and phased in through 1998. The regulations include technical requirements for fuel tanks and piping as well as financial responsibility requirements. Technical requirements include: leak detection, corrosion protection, and spill and overfill protection.

Many states have special technical requirements that are in addition to the standard regulations. California rules would be inclusive of most of the special requirements that can be encountered. Their regulations include:

1. Pre-qualification approval of all equipment and materials used in underground fuel tank systems.
2. Full secondary containment of all tanks and piping.
3. Fill pipes and spill container located within secondary containment sumps. All tank openings including tank gauging within secondary containment sumps.
4. Periodic testing of secondary containment piping, sumps, tanks, and tank monitors.
5. Double wall construction for tank sumps and piping transition sumps.
6. Double containment of vent piping.
7. Continuous positive monitoring of tank, pipe, and sump secondary containment by vacuum, pressure, or hydrostatic method.
8. Precision leak detection testing after installation and backfill using tracer gas method.

2.7 What equipment is needed to outfit underground tanks?

Most underground tank installations require the specification and installation of these devices:

1. Tank hold down straps. The straps are specified and provided by the tank manufacturer to resist buoyancy loads from groundwater.
2. Tank sumps and penetration seals for pipe and conduit. Tank sumps are typically fiberglass or steel. They are typically single wall except in California where they are double wall. The sumps are bonded to a collar on the tank shell that surrounds the tank openings or it is bolted to a tank manhole cover. Rubber assemblies of various designs are used to seal pipe and conduit penetrations into the sump.
3. Manway frames and covers protect the sump risers and other tank equipment risers. They are typically designed to resist vehicle loads and to transfer these loads to the surface concrete slab or manway collar. The manway frames and covers are isolated from the sump risers which are not themselves load bearing, and they also allow for minor settlement of the slab at grade without causing a load on the tank sump. Specialized manyway frames and covers incorporate fill pipe access and spill containers. Manway covers are commonly steel, however composite lightweight or hinged and lift-assist covers are increasingly used for ergonomic considerations.
4. Fill Point Adapters / caps, spill containers, and overfill prevention valves. Fill adapters allow for the connection and sealing of fuel delivery hoses. The fill connection point is located within a 5-15 gallon spill container which is typically a bellowed plastic construction with a water tight load bearing cover. The overfill prevention valve is a mechanical float type valve in the fill pipe within the tank. The float closes the fill pipe at a maximum 90% tank fluid level.
5. Leak sensors for tank interstice, tank sumps, and piping sumps, tank level transmitters, and sometimes electronic line leak detectors are installed at the tank and wired to the tank monitor control panel.
6. Submersible fuel pumps where used are installed through a 4 inch tank opening with a short riser pipe.
7. Suction systems typically use foot valves to maintain pump suction prime, and extractor fittings at the top of the tank for footvalve servicing.
8. Vent caps are.

2.8 What are the primary problems or failures of underground tanks?

The primary causes of failure for underground tanks have historically been (a) corrosion failures to the tank shell, or (b) leakage through top openings when the tank is overfilled. UST regulations enacted in 1988 addressed these common causes of failure, so that they are no longer prevalent, so the common problems have changed.

When installed in accordance with the manufacturers requirements, problems with tanks themselves are not common. The problems are more likely to occur with tank sumps, tank accessories, and piping.

1. Water intrusion into tank or interstice through improper pipe connections on top of tank.
2. Water intrusion into sump through (a) improperly installed or failed sump penetration fittings, (b) conduit that is not internally sealed, c) improper installation or failure of tank to sump seals, (d) surface water entry through top of sump where manways not raised to divert water, or backfill around sump is not open and free flowing.
3. Damage to tank or sump from surface loads where manway covers not properly isolated from tank sumps.
4. Flotation of tanks during installation because of inadequate ballast procedures.
5. Water intrusion at fill pipe spill containers and internal leakage of spill containers.
6. Piping leaks from (a) ground movements, (b) thermal changes, c) ground freeze / thaw, (d) high water table fluctuations, (e) surface loads, (f) ground settlement, (g) damage from construction

To minimize these problems:

1. Specify quality components.
2. Confirm that contractor submittals address the compatibility of tank sumps, sump penetration seals, and piping.
3. Confirm that contractor submittals address tank ballast calculations, along with procedures for ballasting tanks during construction.
4. Require installation and inspection checklists.
5. Require re-testing of fuel system components after backfill, when damage or movement is most likely to occur.
6. Require inspection and certification of system by contractor prior to end of warranty period.

2.9 What maintenance and inspection is required for underground tanks?

Underground tanks have very few moving parts that would require maintenance and inspection. However, the components are continually under stress from ground movements, surface loads, and thermal changes. Even though these stresses are small, they are what cause the tank / sump / pipe containment systems to develop points of leakage.

Most States have enacted regulations for the regular, typically annual, inspection and testing of underground tank / sump / pipe containment systems. The inspections must typically be performed by certified tank installation contractors.

3.1 What are the main types of aboveground tanks?

Aboveground tanks for fuel in the US are of steel construction. While fiberglass and polyethylene tanks are often used for non-fuel liquids, they are typically not approved because of the relatively low temperature failure mode versus steel.

Aboveground steel tanks may be classified as stationary or portable. Facilities installations are nearly always stationary tanks.

United Laboratories (UL) has standards and certifications for fuel tanks and all US building codes recognize these standards. The basic standard is UL 142 Steel Aboveground Tanks for Flammable and Combustible Liquids. The standard includes single wall, double wall, and diked tanks. The standard covers horizontal tanks and also vertical tanks. The standard covers cylindrical and rectangular tanks. So a proper description of a tank would include descriptors such as: UL 142 Steel Aboveground Tank, Double Wall Horizontal Rectangular Construction.

UL 2085 is a standard for UL 142 Aboveground Tanks that also have Fire Rated properties. The fire rating is typically achieved by installing a lightweight porous cement based material between the inner and outer steel shells of the tank. These tanks are commonly required by State and Local fire marshalls to address their concerns about fire safety.

3.2 When should double wall versus single wall tanks be used?

All fire, building, and environmental codes will require secondary containment of aboveground storage tanks. Double wall tanks are commonly used to provide this containment. Double wall tanks have the benefit of excluding rainwater from the containment when they are installed outside.

Diked tanks are single wall tanks with integral steel containment provided by an open top dike. Most double wall tanks will have a secondary containment volume of 5-20% of the primary tanks. In some places the codes may require a secondary containment of 125% or 150% of the primary tank and diked tanks can fulfill this requirement. Diked tanks should be shielded or covered outside to prevent rainwater accumulation.

Single wall tanks are commonly used, either inside or outside of a building, where concrete structures provide the required secondary containment. Typically the concrete is coated with an epoxy or other material to make it impervious to fuel.

3.3 What are the benefits of fire-rated steel tanks?

Fire rated steel tanks provide the benefits of fire- protection and also enhanced physical protection for aboveground fuel tanks. The fire rating is meant to protect the tank from a building fire or from a liquid fire from spilled fuel. The fire rating is typically a 2 hour standard, meaning that if the tank is engulfed in a fire that the contents will be protected for at least 2 hours, based the common standard of response for fire fighting equipment and personnel.

The fire rated tanks also meet a standard for physical protection, typically tested with a rifle bullet. Both rural and urban installations have the possibility for damage by accident or vandalism.

Fire Rated tanks are more expensive that double wall tanks in the range of 50-100% more than a double wall tank. They are also because of their weight more expensive to transport and install.

3.4 What are the site considerations for aboveground tanks?

General Location: The primary site consideration for aboveground tanks is finding a place to put them. Fire and building codes specify required tank separation distances from buildings and property lines. These codes are often based on NFPA 30 and 30A Fire Codes Flammable and Combustible Liquids Code.

Aesthetic / Architectural and Security Other important site considerations are Aesthetic / Architectural and Security. Aesthetic concerns are often addressed by installing architectural walls around the tank area sometimes in conjunction with landscaping. Security may be inherent if the entire property is protected by fencing and security personnel / security systems, but typically the tank area itself is also secured by lockable doors or fencing.

Access to Tank Area: Consideration should also be given to access to the site for fire fighting personnel, and for tank re-filling. If truck access adjacent to the tanks is not practical, then fill piping may be installed from the tanks to a remote fill station.

Drainage from Tank and Tank Loading Area: An important consideration for aboveground tanks is where rainwater or spilled fuel will flow. This is especially important for the fill area where a fuel delivery truck will park and operate. A fuel spill or rainwater with trace amounts of spilled fuel will flow toward the site drainage features. Typically there should be separation of stormwater inlets from tank and tank loading areas, so that if there is a small spill during transfer, that it can be stopped and cleaned prior to flowing into the storm drain. This issue can be addressed in detailed fill procedures, and precautions such as curbing or temporary inlet covers.

Canopies for Tank Areas Large outside tank areas are typically constructed with concrete containment dikes or curbing. Even with double wall tanks, there may be tank connections, equipment, or piping that may leak – and there is the potential for tank overfills. Rainwater or snow accumulation in these diked and curbed areas can be a maintenance issue. The tank areas may be covered with a roof or canopy to alleviate this problem. The canopies are typically open on the sides so that they are not classified as buildings, however there will be some building code requirements for the canopy structures that needs to be considered.

Pipe Routing to Building Tanks will be separated from buildings and will require consideration of pipe routing from the tank area to the building. Pipe supports will be required for fuel piping and sometimes for electrical conduit as well. Portions of he pipe routing may be underground requiring the transition detailing for aboveground to underground piping. Piping installed in concrete trenches is sometimes used instead of underground piping, however water intrusion into these trenches can be problematic.

3.5 What are the construction issues for aboveground tanks?

The primary construction issue is providing a suitable foundation for the tank to avoid settlement issues. A reinforced concrete slab on grade with compacted sub-base will often be sufficient in competent soils. Some installation may require footings beneath the tank supports, or in extreme circumstances piers or piling. In any case the tank foundation should be designed by a competent person.

An important construction safety issue is access to the top of tanks to install equipment and instrumentation. A horizontal cylindrical tank does not provide a proper working surface for personnel Proper access and safety procedures, such as personnel lifts and fall protection restraints need to be implemented.

3.6 What are the regulatory issues for aboveground tanks Tank Volumes State and local regulations will limit the capacity of aboveground tanks?

Some local ordinances may severely limit aboveground tank capacity or even prohibit them. Special rules for fuel dispensing into motor vehicles will also limit capacities for these applications.

Tank Construction Typically regulations will require that tanks be built to UL 142 or UL 2085 standards.

Tank Location Regulations will specify distances of separation for aboveground tanks from buildings and property lines.

Tank Equipment Regulations will typically require proper vent devices for aboveground tanks, overfill prevention valves, Anti-siphon and emergency valves.

Fire Protection / Suppression Fire Protection / Suppression measures may be required by local regulations. Typical requirements may include a piping system to allow for the remote dispensing of foam by fire fighters into the tank containment area.

Leak, Spill, and Overfill Protection Regulations leak monitoring procedures and devices. These may be visual with recordkeeping or continuous electronic monitors. Spill protection is provided by curbs and diking. Overfill protection is usually required as redundant methods such as a high level alarm device and a fill pipe overfill prevention valve.

Spill Prevention Control and Countermeasure Plans (SPCC) SPCC Rules are US Federal and State regulations that apply to certain aboveground tanks. They were originally enacted to prevent problems at large marine oil terminals, which had the experience in several instances of discharging large volumes of oil into adjacent rivers. The regulations apply to tanks over 500 gallons where a discharge could impact a navigable waterway. Since the concept of navigable waterway is broadly interpreted, the regulations will apply to most tanks. The standards require a written plan for the facility with the plan reviewed by a professional engineer, and periodically updated.

3.7 What equipment is needed to outfit aboveground tanks?

Emergency Vents Emergency vents are required by UL 142 and NFPA Standards. The emergency vent is a normally closed device that opens at maximum 2.5 PSI to relieve any pressure accumulating in the tank. The normal vent will maintain the tank at atmospheric pressure under normal condition. The emergency vent is sized so that in a fire condition the vapors generated from the fire heat will not cause pressure to build up in the tanks – they prevent a dangerous explosion. On double wall tanks a second emergency vent is required for the containment space to provide the same protection in the event that there is leaked fuel in that space.

Standard Vents Standard vent caps allow the tank to remain at atmospheric pressure as the fluid level changes. Air enters as the level goes down, and exits as the level goes up. Vent devices are designed to provide the required air flow without obstruction, and prevent water or animals / insects from entering the vent pipe.

Vent Flame Arrestors Flame arrestors are not typically used on normal vents for diesel tanks but are sometimes required by local fire marshalls. Where required the flame arrestors would have particular application where vents discharge on the roofs of buildings. A flame arrestor is a device with a series of metal elements that disperse a flame.

Fill Pipe / Spill Containers In some applications filling of tanks is by connection of the fuel delivery truck hose to a top-of-tank fitting. The fitting is located within a spill containment device, typically of 5-7 gallon capacity.

Overfill Prevention Valves Overfill prevention valves are installed in the fill pipe to automatically close the fill pipe at a 90% tank level. The valve is actuated by a mechanical float located within the tank. Mechanical overfill valves for aboveground tanks differ from thos used for underground tanks. Fuel delivery for underground tanks is typically by gravity at a low pressure of 5-15 PSI, and the overfill valves are rated for pressures up to about 25 PSI. Aboveground tanks are often filled with pups on the fuel delivery trucks which can generate pressures of 100 PSI, and the AST fill valves are rated for this higher pressure. An alternate overfill prevention method is to provide a solenoid valve, or actuated ball / butterfly valve in the fill pipe, with a high level sensor controlling the closure of the valve.

Ground Mounted Fill Stations Larger aboveground tanks are usually filled from the ground through hose connections and valves located within a steel containment box. The piping includes a hose tight-fill adapter (camlock), manual valve, check valve, and overfill prevention valve. Fill Station containment capacity ranges from 5-20 gallons. A hand pump is often included to transfer spilled fuel from the containment into the fill pipe and tank. A high level audible visual alarm is mounted in or adjacent to the fill station, and this may or may not include a tank level indicator gauge.

Direct Reading Gauges Direct reading level gauges are provided for aboveground tanks as a check for tank level / volumes. When an electronic gauge is also used, the manual gauge provides a secondary check. The gauge face must be large enough to be read from ground level.

Submersible Pumps Submersible pumps are used with aboveground tanks in the same way that they are used for underground tanks. They install into the tank and mount to it through a 4" top opening. Since fuel can siphon through the submersible pump, an anti-siphon valve must be provided.

Foot Valves Foot valves are vertical check valves installed at the bottom of suction pipes to maintain prime in suction piping for non-submersible pumps. Extractor fittings are sometimes used at the top of tank fitting to allow for easier removal and maintenance of the valves.

Anti-Siphon Valves Anti-siphon valves are used in suction pipes or at submersible pump discharge pipes to prevent siphon flow from the tank to a lower elevation discharge. Standard anti-siphon valves are spring loaded angle check valves, with the spring sized to resist the static siphon head – typically 5-20 feet of static head. When flow is required, force from the suction pump or submersible pump overcomes the spring force to allow flow. An alternative is to use a normally closed solenoid valve that opens when the pump is activated. The solenoid valve can be less problematic on suction pump applications where the suction pipe characteristics have already placed a significant load on the pump.

Emergency Valves Emergency valves are normally open valves that automatically close based on fusible links. The valves are held open by a link that fails at about 165 degrees F, to shutdown fuel flow in a fire condition. The valves are required for all tank openings below liquid level and these are often a style that internally mounts in the tank fitting. External valves are installed in fuel supply piping systems at the top of tanks, and where piping penetrates through walls into building rooms. The valves may be standard or FM approved valves. A special version of the valve allows activation / closure through fire alarm inputs.

Level Transmitters, Level Switches, Leak Sensors Level transmitters for aboveground tanks may be magnestrictuve type probes as used on underground storage tanks. Since aboveground tanks have a larger temperature change during the day, the in-tank tightness testing capability of the level system, as used on UST systems, is not valid for aboveground systems. Ultrasonic and capacitance based level transmitters are also used.

Level switches are used for high and low level alarm signals. The most common type is a float switch, although capacitance and optical types are also used.

Leak sensors used for tank interstitial monitoring are the same as used for underground tanks and are typically float switches, capacitance type, or optical.

Heaters Heaters are sometimes used for aboveground tanks to maintain diesel fuel temperatures in cold conditions. Heater types are typically an immersed electric heating element installed through the top or side wall of the tank. Steam coils are also available. An alternative method is a circulation heater where fuel is re-circulated through a heater vessel with an internal heating element. Heaters should be properly designed for fuel oil so the temperature at the element itself is limited to a same value. Heaters are typically controlled with a series of thermostats or electronic controller and temperature elements to allow for shutdown on high temperature. Heaters are also controlled to shutdown on low fluid level, that would expose heating elements to air causing overheating, and to shutdown based on ground fault protection of the electrical supply.

Access Steps, Ladders, Platforms Access Steps, Ladders, and Platforms may be required to allow inspection, maintenance, manual gauging, and sometimes filling of aboveground tanks. These structures should be designed in accordance with OSHA regulations that specify their minimum design and construction requirements.

3.8 What are the primary problems or failures of aboveground tanks?

Overfills Overfills are the most common cause of release from aboveground tanks. The key idea in prevention is redundancy. What several methods should be used to prevent overfills: (a) a method – such as an electronic tank gauge- of determining the fuel volume in the tank, and calculation of the available free space to the 90% fluid level, (b) a secondary method for levels / volumes such as a direct reading level gauge, © a third method for level / volume such as a manual gauge stick, (d) procedures for filling tanks only when facility personnel are present for observation and monitoring and lockable fill equipment to control access, (e) a high level audible and visual alarm to warn the fill operation personnel when the tank reaches 85% capacity, (f) an overfill prevention valve to close and stop flow when the tank level reaches 90%.

Accidental Transfer Between Tanks An opportunity for overfills exists when multiple fuel supply tanks are included in a system. System designs should include valve control to allow fuel returns from boiler or day tank overflows to return to the active supply tank. Similarly fuel filtration / polishing systems that serve more than one tank should have the same controls. It is recommended that systems be designed with redundancy of control sensors and methods to assure that accidental transfer between tanks cannot occur.

Spills During Tank Fills Spills during tank filling are likely to result from a failure of some aspect of the overfill prevention system. These failures might include: (a) an overfill valve that does not close, (b) a high level sensor that does activate, © a level measurement that gives an erroneous reading, or (d) a high level alarm that is ignored. These are reasons why redundancy in prevention methods is important.

Water Accumulation Water naturally accumulates in the bottom of tanks because the specific gravity of water exceeds that of fuel. Water enters the tank as moisture in the air which condenses as it cools in the tank environment. Air is drawn into the tank as the fluid level decrease from consumption, or from temperature changes. In areas of high humidity, the removal of accumulated water can become a regular maintenance item for aboveground tanks.

3.9 What maintenance and inspection is required for aboveground tanks?

Visual Inspection The primary inspection requirement for aboveground tanks is regular visual inspection for equipment damage, wear, or leaks. For SPCC plan compliance a written check list and inspection record would be part of the plan.

Maintenance items would include removal of accumulated water from tank bottoms (typically annually), checking of sensors and instruments, and maintenance of coatings.

Tightness Testing State regulations may require tightness testing of aboveground tanks at 1-5 year intervals.

Recordkeeping SPCC regulations require a written record of the plan, records of tests and inspections, records of training facility personnel, response to spill incidents, and periodic management review.

4.01 What type of storage tank is used in a building?

Tanks inside buildings are steel tanks of UL 142 or UL 2085 fire rated construction. They are typically horizontal tanks, although vertical tanks are sometimes used because of the available dimensions of the room.

Tanks may be cylindrical or rectangular. Rectangular tanks are advantageous in that they are somewhat more compact. But more importantly their dimensions can be readily modified to fit through doorways, between columns, and into narrow rooms.

Tanks may be single wall or double wall. Single wall tanks are used where the room itself provides the required secondary containment capacity. Otherwise double wall tanks are more typical.

Fire-rated tanks are sometimes required by local fire marshalls. Often the fuel tank room is required to be constructed for 4 hour fire resistance, and the fire rating on the tank would be unnecessary. Also the greater weight of the fire rated tank might require additional structural characteristics, or special procedures during installation.

4.2 What is the largest tank capacity that can be used?

Fuel storage volumes inside buildings can range up to over 100,000 gallons – as the main storage on the lowest level of the building.

Fuel storage volumes – above the lowest level of the building are highly restricted. Local building codes may limit the volumes to 50, 250, 550 or other restricted volume. The limitation may be on the tank size or the total volume in the room. The importance of the limitation is to limit the size of the generator day tanks.

4.3 How is fire protection provided?

The primary means of fire protection is the fire rated construction of the fuel storage rooms. Beyond this requirement the room would typically be sprinkler protected. In some cases foam fire suppression systems may be required by local code or fire marshall.

Fuel storage rooms with sprinklers, create the question of what happens to the water generated, since it may be mixed with fuel. Some codes address the issue by requiring a containment capacity for the fuel volumes plus the fire protection water, and this volume can be problematic. Other regulations may require that the discharge from the room be handled appropriately such as being directed to a remote holding area or underground tank.

4.4 Should the room be ventilated?

The issue of ventilation in tank rooms will be addressed in local building codes. Typically the ventilation for a tank room is separated from the other ventilation systems for the building. The issues are these: (a) since people enter the tank room, ventilation is required, (b) since fuel is present in the room, air quality monitoring such as a hydrocarbon sensing is often required, c) since fuel vapors are heavier than air, exhaust systems need to be effective at the floor level, (d) if there is a fire in the room the ventilation should stop to prevent air from feeding the fire, and (e) since the exhaust air may have fuel vapors it should be separated from the other ventilation for the building.

4.5 Does the electrical work need to be explosion-proof?

Diesel fuel commonly used for generators is #2 Diesel which has a flash point of about 120 degrees F. This would classify diesel fuel in NFPA standards as a combustible and not a flammable liquid. Explosion proof electrical construction is required for flammable liquids, but not typically combustible liquids. So fuel rooms in buildings are typically ordinary electrical aras and not explosion proof.

However, local fire codes – or the facility insurance requirements, may specify that the fuel storage room is a hazardous electrical area. This classification may be either Class 1 / Division 1 meaning the conditions for fire / explosion are always present, or Class 1 / Division 2 meaning the conditions are present under upset conditions.

Class 1 / Division 2 Construction can be accomplished by (a) control panels and devices to be constructed of all C1D2 approved components, (b) explosion proof motors, (c) all contactors and spark potential devices located within NEMA 7 explosion proof enclosures, (d) control panels and devices to be constructed of all C1D2 approved components, (e) intrinsically safe or explosion-proof instrumentation and sensors, (f) rigid steel conduit with seals at the area boundaries.

Class 1 / Division 1 Construction would not allow item (a) above. Control panels would need to be in explosion-proof enclosures – or more commonly, located outside of the room in an ordinary electrical area.

Lighting, utility outlets, and other electrical devices in the rooms also need to be addressed for the hazardous electrical environment.

4.6 What is required for doorways and access?

Access and egress for fuel tank rooms typically has the same requirements as other rooms in the building. Rooms over a certain size may require 2 means of access.

The 4 hour fire rating for the room construction can sometimes be problematic, because standard door constructions may not be available in 4 hour rating. In some instances, doorways are constructed as double door entry to fulfill the requirement.

Another aspect of access egress is that the fuel storage room has a floor and lower wall space that provides secondary containment. Stairs are often required to allow access over the containment wall, and these steps are sometimes problematic to layout given the limited room dimensions and size of the tanks.

In some cases, the only entry into a tank room is through the roof / ceiling. Manway covers should be designed as hinged or lightweight construction. Ladders are sometimes required to be non-sparking construction.

4.7 Is a tank room an OSHA confined space?

A confined space is defined by OSHA as a space with limited or restricted means for entry or exit, and not designed for continuous employee occupancy. So properly lit and ventilated tank rooms with adequate access and egress may avoid the confined space designation.

A tank storage room may be constructed like a vault with access only through roof openings, and this type of room, would typically be considered a confined space. Because the room has fuel in it, the space would further be classified as a permit space with additional safety requirements for personnel entry.

4.8 How are tank vents terminated when tanks are located in buildings?

Tank vents are required to be located outside of buildings and typically above roof lines and minimum 5 feet from building openings. Additional considerations for the termination points are that (a) 5 feet would seem inadequate if the building opening in a ventilation air intake, and (b) 5 feet may be inadequate as a separation from the potential high heat of generator engine exhaust.

The normal breathing vent for a tank lets air in as the tank level deceases, and let sair out of the tank when the tank is filled. So it is pretty obvious that this vent should terminate outside because it will regularly discharge fuel vapors. Emergency vents are normally closed and would operate only in a fire conditions, so the need to terminate the emergency vent outside is sometimes debated.

The termination point for emergency vents is an important consideration. While a normal vent for a 10,000 gallon tank would be 2" piping, the emergency vent would be 10" piping, and the emergency vent for the secondary space would be another 10" pipe. In some places it would be required to terminate all of these vent pipes outside the building, and sometimes for architectural reasons this means through the roof of a 3-100 story building. It can be a highly significant cost issue, and also be a highly significant space and cost issue because of the riser space required. It is typically a local requirement and should be checked early in the design process. In some cases the vent piping is several times the cost of the fuel supply, fuel return, and vent piping.

Another aspect of the emergency vent termination is that if the tank is overfilled, and the fuel rises up through the vent piping, then the tank could experience a liquid head pressure that is beyond its design pressure, causing it to burst. Where vent piping is used for emergency vents, a vent pipe liquid sensor should be installed to function as an emergency stop.

4.9 How are tank accessories installed with low ceiling heights?

Tanks inside buildings are often installed in rooms with limited ceiling heights. This can be a problem for the installation of tank equipment. For example, there may be 3 feet of clearance above the tank and with a tank diameter of 8 feet a level transmitter installed into the top of the tank may be 10 feet in total length/

One solution is to provide floor openings and access doors in the floor slab above the tank, but in most cases this is impractical.

Level transmitters are available from several manufacturers in flexible models which can bend to be inserted into the tank. Drop tubes and suction pipes may be installed as segmental pipes which are joined as they are installed into the tank.

It is recommended that gauges and instruments be installed at the end of the tanks where they can be readily inspected and maintained without having to have a person gain access to the top of the tank.